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ARTICLE IV.

Observations on the Changes of Colour in Birds and Quadrupeds. By John Bachman, D.D., President of the Literary and Philosophical Society of Charleston, S. C., &c. Read May 19, 1837.

No attentive observer of nature can have failed to remark the striking and wonderful mutations to which some birds and quadrupeds are subject, from the young to the adult state, and at different periods of the year. The young of our Indigo bird, and Blue Grosbeak, are clothed with brown, but in the adult state are brilliantly blue. The young of the Painted Bunting is of an humble ash colour; and, after undergoing a succession of changes, puts on a livery of bright purplish lilac, vermilion and glossy green. The young of the White Ibis and the Whooping Crane wear a homely brown garb, whilst the adult is pure white; on the other hand, the young of our Blue Heron and Reddish Egret are white; and the adult in the one case bright blue, and in the other rufous. There are other birds, such as the Reed bird, the American Goldfinch, the Yellow crowned Warbler (S. *coronata*), and various species of Gulls and Sandpipers, that disguise themselves so during six months of the year, whilst on their migrations, as to be with difficulty recognisable. Some of our quadrupeds also, as if seeking for notoriety, at one season are clothed in white; and, as if courting obscurity in the other, assume the humbler dress of the earth and the dried leaves around them. To account for these mutations, or even to

describe the process by which they are effected, has been a source of much perplexity to naturalists and philosophers. In Europe, Cuvier. Temminck, Yarrell, Drs Flemming and Whitear, Mr Montagu, and several writers in the recent numbers of the journals of Paris, Dresden and Halle, have indulged in various speculations, and adopted a number of contradictory theories. Some have contended that birds moult but once, others twice a year; some that the annual mutations are produced by a gradual fading or brightening of the feathers; whilst others have contended that it is produced by a sudden moult. Dr Flemming, who adopts the theory that the feathers of birds do not arrive at maturity and drop off till they are a year old, supposes that those feathers which are received in spring, remain till the following spring, and that those added in autumn, moult on the succeeding autumn, thus making two irregular moultings in a year. One school of naturalists has supposed that the change in those quadrupeds which become white in winter, is effected by the gradual lengthening and blanching of the summer fur; whilst another presumed that this wonderful mutation can only occur by a shedding of the summer hair, which is replaced by the snowy pelage of winter. In our own country, few observations have been made on this subject. Our celebrated ornithologists, Wilson, Bonaparte and Audubon, appear to have dwelt very sparingly on the changes of plumage in birds, which, however overlooked, seems to belong to their department; and, with the exception of a paper by Mr Ord, in the Transactions of the American Philosophical Society, I do not recollect having read any article on this department of the physiology of birds and quadrupeds. In our investigations of nature, we are perhaps too prone to build our theories first, and afterwards seek for the facts which are to support them. Hence, naturalists, having the same field of inquiry before them, and reading from the same book of nature, which is open to all, are very apt to be swayed by their preconceived notions, and thus retard the progress of science by unprofitable disputes.

The time perhaps has not yet arrived, when any certain theory can be built on this part of physiology. A sufficient number of experiments and observations have not been made with care and judgment; nor have such a body of facts been collected as will enable us to judge

which theory is founded on nature and truth. Systems which we adopt in haste, from an examination of a few isolated facts, without awaiting the slow progress of time, are frequently obliged to be abandoned in after years. When Bonaparte wrote his long, spirited and interesting article on Peale's Egret Heron, and framed his theory that "the Egret Herons are entirely of a snowy whiteness, without any coloured markings on the plumage whatever," he could not have conceived that the next student of nature who visited the spot where his specimen was obtained, should discover that this identical species became brown and rufous; and thus compelling nature herself to scatter his fine spun theory to the winds.

It is proposed in this article to give such facts relating to the moulting of birds and quadrupeds, as some experience has enabled me to collect. Should this have a tendency to elicit further inquiry, on a subject so interesting to naturalists, and lead to the study of the causes of these wonderful changes, my object will be attained.

1. Does the change of plumage in some birds arise from a change of feathers, or from the feathers themselves assuming at one period a different colour from that which they have at another?

On this head the following observations were made.

Falco leucocephalus. A pair of birds were sent to me in the spring of 1830, taken from a nest in the neighbourhood of Beaufort, S. C., two years before. The old birds having appeared unusually large, and destitute of the white heads and tails of the Bald Eagle, the individual who had preserved the young, sent them to me under an impression that they were the long disputed Sea Eagle (F. *albicilla*) of Europe. Perceiving that they were the young of our F. *leucocephalus*, and being aware that some of these birds, when in confinement, required five and six years before they attained their full plumage, I did not much value these troublesome and expensive pets. On a closer examination, however, I observed that the male had some of the feathers of his head streaked with white, whilst the outer edges were bordered with brown. I discovered also, when he spread out his tail, that some of the inner portions of his feathers were broadly and irregularly patched with white. I concluded that the important change I was desirous of witnessing was in progress. The birds were therefore carefully fed and

noticed. The female had evidenced no appearance of change, or progress towards a change, until the moulting season arrived. This commenced in June: both birds moulted freely, the female three weeks later than the male. In the latter, the feathers of the head came out nearly pure white; those of the tail continued still irregularly barred with brown and ash, but became gradually whiter till about the latter end of October, when he had all the markings of an adult bird. The feathers of the female assumed nearly the colours of the male, at the time I first received him. In the beginning of November, all further change in the plumage of the female appeared to have been checked. The birds remained in my possession till the following January, when they were sent to Europe.

The above observations, in addition to the facts they present with regard to the process by which changes in colour are effected in this species, enable us to form some idea of the time it may require to produce the full plumage. Birds in confinement, deprived of the exercise, air and food to which they are accustomed in a state of nature, often moult irregularly, and the time they attain full plumage is considerably protracted. An individual of this species which was for some time in my possession, did not moult for eighteen months, although apparently in good health; and when at last this process took place, it was in January, the coldest month of the year in Carolina. In the present instance the male received the white feathers in his head and tail a year earlier than the female, which, I have reason to believe, would not have been the case if they had been left at liberty. Here, however, is one instance established, with a tolerable degree of certainty, of this species arriving at full plumage in three years.

Strix asio. The young of this species was first described under the above name; and the old as *strix nævia.* Its general colour above is reddish brown, but when it receives its mature plumage it is mottled with white, ash and pale brown. I have possessed very few opportunities of examining the change of plumage in this species. Having, however, once found an individual sitting on its nest while yet in the red stage, I conclude that they do not arrive at full plumage till they are more than a year old.

In the month of February (the year was not noted, and is unneces-

sary to our present inquiry) I saw in the possession of some lads, who were dragging it through the streets by a string, an individual of this species, so singularly marked that I was induced to ask them for it. They stated that they had found it with a broken wing in the woods. The wing was nearly severed, but the wound apparently healed; a proof that the injury was of long standing. The bird, though lean, was in moult. The lesser wing coverts, a portion of the head, and an irregular spot on the breast, had nearly attained the markings of the mature bird; the rest of the feathers that had not been moulted remained the colour of the young. It survived but a few days. Whether this was a spring moult, or that of summer retarded in consequence of the wound, I had no means of ascertaining.

Psittacus Carolinensis, Carolina parrot. This bird has become so rare in Carolina, that I only once noticed a small flock of five or six among the cypress trees of the Salt Katcher swamps. In the autumn, however, of 1831, a friend received from St Augustine five young birds of this species. They were never in my possession, but I visited them occasionally, and scarcely ever without the expense of a wound, which they were at all times ready to inflict upon any strange visiter. They continued in the uniform plumage of the young of this species till the beginning of February, when they all about the same time commenced moulting, more perceptibly and more extensively in some of the individuals than in others. A striking increase of brightness was visible in all the new feathers. Those on the neck, which first came out a yellowish green, gradually and irregularly became bright yellow; but in all cases, as far as I had an opportunity of judging, the change of plumage was in the new feather. Absence from the city prevented me from seeing these birds after they had arrived at full plumage.

Icterus Baltimore, Baltimore Oriole. The only opportunity afforded me of observing the changes of colour in this beautiful species, was in the state of New York, in May 1815. A young male had been obtained and confined in a cage, where it was for some time fed by its parents. In the month of October of the same year it moulted; the young feathers were much brighter than those which were dropping out; and in two months afterwards the bird was in full plumage. Our

ornithologists, Wilson and Audubon, who state that this bird requires three years before it arrives at full plumage, may have been led into this mistake from having seen birds of the late brood of July, not in perfect plumage in the following spring. Mr Audubon, indeed, recently informed me that he had satisfied himself of this error, in examining an aviary kept by some gentleman in Baltimore, and I acknowledge myself indebted to him for the hint which induced me to refer to the long neglected notes I had made on this species.

Icterus spurius, Orchard Oriole. This sprightly species was for several years preserved in an aviary, where I employed my leisure moments in studying the habits of this beautiful race. There, among various others of the feathered tribe, it built its pensile nest, and reared annually two broods of young. Its curious *gestures*, its varied and often melodious notes, as well as its continually varying colours, rendered it one of the most interesting and admired species. The young were yellow on the under surface, and the males could scarcely be distinguished from the females. They moulted in autumn, the last brood not until January, being two months later than the first. There was no perceptible change in colour for two weeks, when the birds of the first brood assumed the black patch under the throat; the later birds still remained yellow in those parts. They retained these colours during spring, whilst they were engaged in the cares and duties of reproduction. The moulting season now commenced in August, when the elder males became mottled on the back with irregular streaks, and the younger assumed the black patch under the throat. In the month of January the first assumed the bright chestnut colour on the breast, and were in full plumage, and the others but one stage removed from it; thus passing through all their variations of colour to their full plumage in less than two years. Our naturalists have extended the time to four years; a pretty long time to be concealed under a mask.

Fringilla cœrulea, Blue Grosbeak. A pair of young birds of this species was taken from the nest in May 1836, and raised by a friend, who since presented them to me. They were then of an humble drab colour, and commenced moulting about the beginning of December. The female died in the moult. The new feathers in the male came

out blue, edged outwardly with brown; the moulting has proceeded rather slowly, owing, no doubt, to the cold weather. On the 21st of March young feathers were still making their appearance on various parts of the body, whilst the first feathers that appeared after the moult were bright blue, even to their extremities; the latter ones are still, along their outer edges, near their points, tipped with brown and drab, which continue to brighten as the feathers become more matured. The male undoubtedly attains his bright and perfect plumage before he is a year old. Although I have occasionally seen a young male in early spring with a few brown feathers (the result, no doubt, of an imperfect moult), yet, out of many hundreds that I have noticed in the breeding season, I have never seen any males that were not in full plumage. They are not subject to a change of colour during winter, as supposed by Wilson, nor do they require three years to attain their full plumage, as stated by Audubon.

Fringilla ciris, Painted Bunting. This beautiful and social species is very common among the caged birds of the south. Having long preserved it in an aviary, where it raised two or three broods in a season, I have it in my power to state, from personal observation, the changes through which it passes from immature to perfect plumage. For the period of a year, the male strongly resembles the female, being of an olive green colour above. The birds moulted late in autumn, without any perceptible change of colour. In this homely dress they in the following spring commenced building their nests, rearing their young, and, with their sprightly song, cheering the females engaged in incubation. In August and September they began to moult; the new feathers on the head came out bright blue; those on the breast of a light ash colour, tinged with carmine; the colours on the head appeared to have been received in their full perfection, immediately after the moult; those on the breast and neck continued to brighten gradually for some weeks. The perfect plumage, as far as it is acquired in this species in confinement, was obtained in less than two years. Our ornithologists have assigned the period of four or five years for this process. To the objections which may be urged against experiments made on birds in confinement, as affording no certain guide in ascertaining the time at which they arrive at full plumage, it may be ob-

served, that in caged birds, excluded from the full influence of sun, air and suitable food, the period may be extended, but not accelerated.

The above instance may suffice to show the process which nature pursues in effecting the changes of plumage, from the young to the adult state, in land birds. I shall, therefore, omit adding the notes I had prepared on several others: particularly on those of *Polyborus vulgaris*, Carracara Eagle, from Florida, a pair of which I have now in confinement; *Falco borealis*, Red Tailed Hawk; *Picus erythrocephalus*, Red Headed Woodpecker; *Fringilla cardinalis*, Red Bird; *Tanagra rubra*, and *æstiva*, Scarlet Tanager, and Summer Red Bird; *Columba leucocephala*, White Crowned Pigeon, &c. In all of them, however, there is a striking uniformity, the changes being effected during the space of a year, and in most of them the feathers become gradually brighter immediately after the moult.

I shall now proceed to note a few observations on those water birds that are subject to striking variations in plumage, from the young to the adult state, which will prove that nature, although varying in some particulars in some of the species, is still subject to the same general laws.

Grus Americana, Whooping Crane. The young of this bird is of a brownish ash colour, and at a year old is still one fourth smaller than the adult bird. In this state it has been considered by all our writers on American ornithology, with the exception of Audubon, as a distinct species.

Grus Canadensis, the Canada Crane. Dr Richardson, who found its eggs (which were smaller than those of the Whooping Crane) in the polar regions, is also under the impression that it is a distinct species. It will be recollected, however, that all our birds, as far as we are acquainted with their histories, breed at a year old, even before they have attained their full plumage; and that young birds lay smaller eggs than old. How long a time the Whooping Crane requires to arrive at full maturity, I have had no means of ascertaining. I however had an opportunity of witnessing the change of colour in a pair of this species, which convinced me that the Canada Crane was the young of the Whooping Crane. The birds were obtained, it was said, from Florida, in what manner I was not informed, and were represented as

two years old. They were very tame, feeding from the hand, and evidencing no vicious disposition; preferring, as food, the sweet potatoe (*Convolvulus batata*) and Indian corn (*Zea mays*). They had not quite completed their moult. They appeared a shade lighter than the Canada Crane, and considerably larger. The feathers were white nearly to their extremities, where the ash colour prevailed; the brown edges on the feathers continued to become narrower. At each successive visit the change was rendered more visible. In a few weeks some of the feathers became pure white, while others were slightly tinged with a cinereous colour. The change was not perfect, though nearly so, when the birds were removed from the city, and all who saw them unhesitatingly pronounced them Whooping Cranes.

Ardea cærulea, Blue Heron. Our writers on American ornithology were not, until recently, aware that the young of this species was white. In this state of plumage it so much resembles the Snowy Heron (*Ardea candidissima*) that it can scarcely be distinguished from that species, except by its black legs and toes. I had many opportunities of witnessing the changes of plumage to which this bird is subject, and discovered that, both in captivity and in a state of nature, the time and process do not materially vary. The young birds continue pure white till late in autumn, when they moult. No perceptible change in colour takes place, except in a very few instances; a few feathers have a slight tinge of blue near their inner webs. All the old birds retire south of Carolina in winter; a few of the young, in white plumage, remain. When this species return from their winter retreat in Florida and Mexico, they possess their beautiful trains, some white, others white and blue. Even in spring, a few new feathers may be seen here and there pushing forwards, and are easily known by their having a tinge of blue. On some the breasts are spotted; some of the feathers having become blue, others still remaining white: every where, however, a tendency to the change which is approaching, is visible in each new feather, its inner vaine being more or less marked with blue. A few still continue white, probably the late brood of the former year. It is amusing to witness the breeding place of these birds. A thousand nests may sometimes be seen on some small islands among the reserve dams of the rice fields of Carolina. Here is seen an indiscri-

minate mixture of all colours, engaged in incubation and providing for their families. A blue male may be seen mating with a white female, a blue female choosing for her companion a white male. Birds strangely spotted, some with white, others with blue trains sweeping through the air, rising in hundreds over your head, and presenting so many variations in plumage, that the young ornithologist is tempted to believe that he has a half dozen new species to describe. In August a regular moult commences, and before the old birds leave Carolina, in autumn, they have acquired their blue colour; thus attaining their full plumage in less than two years.

Ardea rufescens, Reddish Egret. This Heron, which I have had in a state of domestication, in its changes of plumage, and the period in which these changes are effected (as far as an imperfect experiment was made), seems to partake strongly of the character of the last mentioned species.

The various and opposite changes which our species of *Grus* and *Ardea* undergo, from the young to the adult state, is striking and wonderful. In all of them there is no perceptible difference in the plumage of the sexes of each species, except in the least Bittern (*Ardea exilis*), where it is very striking. In the *Ardea herodias*, *A. minor*, *A. Ludoviciana*, *A. virescens* and *A. exilis*, no very striking mutations take place, from the young to the adult. The *Ardea occidentalis* (great White Heron of Audubon), *A. alba* and *A. candidissima* are white in all stages of growth, and at all seasons. The *Grus Americana* and *Ardea nycticorax* are ash or brown, when in the first year of their existence, and then the former becomes white, and the latter greenish black and white; whilst, on the other hand, the *Ardea cærulea* and *Ardea rufescens* are white when young, and blue or rufous when in full plumage.

Plotus anhinga, Black Bellied Darter. I discovered several nests of this rare and singular species in the immediate vicinity of each other, in one of the dark and gloomy morasses of Carolina in June last. No naturalist has heretofore spoken as having seen its nest, except Mr Abbot, in his letter to Mr Ord, who describes the eggs as blue, and the nest containing six young and two eggs. I have sometimes thought that my excellent old friend mistook some heron's nest for that of this

species, as the nests I examined contained only three eggs, and in one instance four, on which the females had for some time been sitting, and the eggs were white, covered over with a calcareous matter, like those of Cormorants. The young were brought home, fed on fish, and became very familiar and amusing. The sexes, when young, are alike of a brown colour. The male commenced moulting in November. The young feathers came out black, and seemed to assume nearly all their bright colours immediately. When it had nearly arrived at full plumage, in January, it was unfortunately killed by a dog, in revenge for the severe bites it was wont to inflict on all intruders upon it at meal time. In this species the full plumage is received before it is a year old. In all the instances I have enumerated, it will be perceived that in the changes which occur in the plumage of birds, from the young to the adult state, nature is nearly uniform in her operations. That these changes occur immediately after the moulting of the bird, and that many feathers may, in process of time, become of a different colour; in short, that the colour may change without a change of plumage.

This leads to a further inquiry.

2. Whether old birds, whose plumage has arrived at full maturity, are subject to the same general law with those who advance from immature to perfect plumage. In other words, does their plumage become perfect at once, or is it subject to gradual changes, as in the case of young birds?

It is admitted that in a great majority of birds, as in the Crow, Blackbirds, Blue Jays, &c., these colours are permanent, and there is no perceptible change in colour from the formation of the feathers till they have matured and drop off. But in many species this is not the case. Many instances have fallen under my observation, to satisfy me fully, that feathers change their colours in adult as well as in young birds.

A female wild Turkey was sent to me eighteen months ago by my friend Dr Tidyman, in order to enable me to ascertain whether this species, when taken wild and full grown, could be domesticated. It had been just caught in a trap, and was excessively wild. By subjecting it to confinement with the tame variety, and excluding the light,

in part, it lost all its wild habits, and eventually became so gentle as to approach my hand to be fed. In the month of October last it moulted, like the tame turkeys, with which it now associated. But I was surprised to find many of the tail and wing feathers, and some of the feathers on the back, coming out of a light ash colour, whilst others were nearly white; insomuch, that some of my friends were induced to pronounce it only one of our varieties of the tame turkey. Shortly afterwards these feathers began to change in colour, and gradually become darker and brighter, till, after the expiration of a month, it had again all the rich plumage of the wild female turkey.

A male of the Summer Duck (*Anas sponsa*) has been in my possession for several years. In the moulting season, which occurred in August last, he lost all his fine plumage, and the new feathers were at first so much of the colour of the female, that the sexes could scarcely be distinguished by the plumage. Shortly afterwards, however, a change commenced; from day to day the beautiful tints of the male were returning; his rich colours were gradually restored; and in the course of six weeks, this, the most elegant of all the species, was again in full plumage.

These observations are calculated to strengthen the opinion advanced by the Rev. Mr Whitear, contained in the twelfth volume of the Transactions of the Linnæan Society of London, that "a change in the colour of the plumage of birds does not always arise from a change of feathers, but sometimes proceeds from the feathers themselves assuming at one season of the year a different colour from that which they have at another."

To this theory I am disposed to subscribe, to a certain extent, and under some limitations. That feathers are changed in colour, without a change of the plumage, is admitted, and, I think, satisfactorily proved. But, as far as I have been able to ascertain, this change is always preceded by a recent moult.

At this stage of our inquiries we arrive at an interesting point. There are many birds that are subject to a semi-annual change of colour, after they have arrived at full maturity. The male Rice Bird (*Emberiza oryzivora*) is of a brownish yellow colour during six months of the year, and returns to its breeding place, in the northern

and middle states, clothed in a livery of white and black. The male American Goldfinch (*Fringilla tristis*) is of a homely olive brown colour during winter, whilst in summer it is a bright yellow. The Yellow Crowned Warbler is ash coloured during half of the year; of a beautiful blue in the other. Our Plovers, Tringas, Gulls, &c., are subject to the same changes. Our ornithologists have widely differed in investigating this part of the physiology of birds. The subject of inquiry here seems to present itself under a new aspect, and the inquiry is:

3. Do birds which are subject to these semi-annual changes in plumage receive their new colours in the spring, in consequence of a fresh moult, as they do in summer, or are they produced by a gradual fading or brightening of the feathers, without a fresh moult?

Mr Ord, in a well written article published in the third volume, new series, of the Transactions of the American Philosophical Society, has advanced the following theory. "It being now satisfactorily proved that a change of colour obtains, in some birds, in the winter and spring, without a change of plumage, I am disposed to conclude that the state of moulting, properly so called, takes place in all birds but once a year."

To this theory the following difficulties seem to present themselves. The colour in the plumage of birds, especially in the small feathers, most subject to a change, appears to be advanced to the extent it is intended to arrive at, in a few weeks, or, at furthest, in a few months. At that point it seems to become stationary, and to remain so for a considerable length of time. If the same feathers are afterwards to receive a fresh set of colours, there must be some secretions in the body of the bird, and a fresh impulse given to the feathers already advanced to maturity, imparting to them properties which they did not possess before. When it is necessary for a bird, in summer, to receive a new dress, differing in colour from the old, there are no secretions by which it can impart fresh colouring matter to its old feathers, which have long become stationary in their growth and colour. It is, then, essential that these feathers should be thrown off, and those substituted, which, in the progress of their growth, and their advance to maturity, may receive those hues destined for them by nature. This law of

nature seems to be so simple, that it can be easily comprehended; but if a different and opposite process is observed, in giving new and entirely different colours to the old feathers of the bird in spring, the law of nature, so uniform in other respects, cannot be traced. The feathers and other appendages in birds may (without adopting the nice distinctions and scientific terms used in botanical science) be compared to the leaves and other appendages of plants. In early spring, the juices, together with the influence of sun and air, impart that nourishment which causes the leaf to expand, and assume its beautiful colours; but when the leaf has arrived at maturity, no fresh growth of the tree will give a new colouring to its leaves. New ones may be formed, and these may continue to grow and flourish, but the old ones fade and drop off. Even among our evergreens of the south, whose leaves are persistent, as the orange tree, &c., which may be said to have two periods of growth (April and September), the leaves, when once matured, seem to have lost the power of further circulation; they cease to grow; their rich colours fade; and they only await the time appointed them by nature, to return to the ground. If the feathers in birds, then, which have been long stationary in their growth, are capable of receiving a new set of secretions, and of assuming opposite colours, we must seek for some new law of nature, not hitherto understood.

The origin of the feathers is the matrix which is placed in the skin, or under it. The structure of the matrix is a pulpy substance called bulb, and a capsule, which is composed of several layers. The bulb furnishes the material of the stem and vane, which, when complete, disappears, leaving no residue but the almost imperceptible ligament, connecting the quill to the bottom of the cavity, which receives and embraces it. Whenever a new feather is to be formed, a new matrix is necessary to the process. The early connection of this matrix with the body, is by means of vessels. From these the pulp or bulb derives its nourishment. The feather is, whilst young, enclosed in a sheath, and this, as well as the quill itself, is filled with a coloured fluid. In a few weeks the secretions have been imparted to the feathers, and the sheath, by a process of absorption, becomes dry, and is rubbed off. In the tube of the feather now remains a jointed membranous body, which every one has observed in the barrel of a common

quill. This shaft is now filled with air. After this process, the object of nature in providing covering and the means of flight to the bird, seems to have been accomplished, and the feather ceases to grow.

In order to renew the nourishment of the quill, it would be necessary to renew the vascular connection. It is doubtful whether any revivescence of colour can take place without this. As long as this lasts, the assimilative powers within the feather may continue to act. When this ceases, these are extinguished with it. As the vascular fluid, then, which fills the sheath and the quill gradually disappears, as also the bulb which nourishes it, after the feather has arrived at full maturity and becomes stationary in its growth, it would appear that after this period no further change of colour can take place. This point, however, has not been so satisfactorily investigated by physiologists, as to enable us to express a positive opinion, and, until this is done, we are obliged to resort to an examination of individual species, in order to ascertain how far there is a uniformity in these changes of colour in all birds.

The fact that birds in winter are, by a wise Creator, furnished with a thicker covering than they possess in summer, does not appear to have received that attention from naturalists who have made inquiries on the subject, that its important bearing on this point seems to require. Several of the birds subject to these semi-annual changes in colour, spend their winter in climates comparatively cold. The *Sylvia coronata* is seen by thousands in Carolina, where the thermometer, during winter, stands for several days in succession, below the freezing point. The *Fringilla tristis* also braves our coldest winters; and the *Saxicola sialis* and *Sylvia petechia* linger among our copse woods and orange groves. These birds are clothed with a covering suited to the rigorous season. In summer their dress is lighter, as well as more gaudy. If, then, there is no dropping off of feathers, it would be reasonable to inquire what becomes of their winter clothing? This would have to be borne through all the heats of summer, till the moulting season; and their thick blanket of down would damp their ardour, and silence many a joyous song.

I am well aware, however, that we may build theories, and indulge in speculations, which, however plausible they may appear, and however

satisfactory to our own minds, may be easily overturned by a single glance at the manner in which nature performs her operations. Admonished, therefore, to resort to a better book than philosophers can write, the book of nature itself, I was determined in some hour, not devoted to any higher pursuits, to make the inquiry by a simple examination of facts, not difficult to collect. The point in dispute seemed susceptible of an easy solution, by a careful examination of those birds that are subject to semi-annual changes of colour, and to ascertain if they moulted once or twice in a year.

The following was the result of my investigations. I copy from notes taken on a succession of visits into the country.

February 23, 1837. Visited a country residence about two miles from Charleston. Slight indications of early spring. Weather windy and unsettled; a slight frost during the night. A few of the trees in the city in blossom, especially the peach and plum. In the country the *Laurus geniculatus*, *Prunus chicasa*, *Acer rubrum* and *Salix nigra*, the only trees in bloom. Procured a number of specimens in ornithology.

The following had no change from winter plumage, and no appearance of a moult. Mocking Bird (*Turdus polyglottus*), one specimen. Pine Creeping Warbler (*Sylvia pinus*), two specimens. *Sylvia coronata*, two specimens. Solitary Thrush (*Turdus minor*), one specimen. White Eyed Fly-Catcher (*Vireo noveboracensis*), one specimen. *Fringilla tristis*, ten specimens, of both sexes. The males of the latter species differed considerably in colour in the different specimens. Whilst some strongly resembled the females in their plumage, others were considerably brighter in colour, especially on the breast; and in two or three specimens there were irregular markings of black on the frontlets, as if nature during the last moulting season had been making an effort at advancing the birds to the bright plumage of which they had just been deprived.

The following had commenced moulting. Wax Bird (*Bombycilla Carolinensis*), two specimens, males. Both birds were considerably advanced in the moult; new feathers, in great quantities, were coming out on every part of their bodies; these were much more brilliant than the old, and seemed to receive their bright colours at once. Crested

Titmouse (*Parus bicolor*), one specimen, moulting along the sides and on the head. Solitary Fly-Catcher (*Vireo solitarius*), one specimen. (This bird, contrary to the assertions of ornithologists, has a soft and melodious song. It is becoming more common every spring.) A great many young feathers were appearing on the head, around the lores of the eyes, and on the breast and back. Savannah Finch (*Fringilla Savanna*), one male specimen; far advanced in the moult; about one half of the feathers on the breast young, and still sheathed. Bay Winged Bunting (*Fringilla graminea*); a row of young feathers appearing on each side of the neck. Chipping Sparrow (*Fringilla socialis*); moulting commenced on the breast, and a few young feathers on the head.

The same day I examined some living birds, in a state of confinement. The male of the Caraccara Eagle (*Polyborus vulgaris*), flew fiercely at my face whilst I was inspecting the female. Neither of them was in moult. The English Pheasant (*Phasianus colchicus*), the Wild Turkey (*Meleagris gallipavo*) and Virginian Partridge (*Perdrix Virginiana*) showed no indication of moulting. This was also the case with the different species of pigeon, and among all the *Emberizæ* and *Fringillæ*. The Song Sparrow (*Fringilla melodia*) was only shedding its feathers.

March 3. Visited the country. No very perceptible advance in vegetation. Nights cool, with slight frosts. The only additional plants in flower were *Leontodon taraxicum*, *Laurus sassafras* and *Oxalis stricta*. These facts, with regard to the advance of spring, are noted in order to enable us to form some idea of its probable effects on the time of the moulting of birds.

Obtained the following birds.

Bombycilla Carolinensis, fifteen specimens. About one half of this number were moulting on the breast, neck, and under the throat; some of them extensively; and in one of them especially, it appeared as if every feather on the body, except those in the tail and scapulars, was already replaced by new ones, half formed. In some of the specimens moulting had not yet commenced, or had already been completed. Bonaparte states, in regard to the genus *Bombycilla*, "that they moult once a year." *Fringilla graminea*, two specimens, moulting exten-

sively on every part of their bodies. I noticed that these two birds, which were males, were in full song. *Fringilla socialis*, two specimens. In one a large quantity of new feathers were coming out from the sides; and in the other the whole head was covered over with young feathers still sheathed. *Troglodytes ædon*, one specimen. Far advanced in the moult along the breast.

The following had no appearance of any change in colour or of moulting.

Fringilla hyemalis, two specimens; *Fringilla cardinalis*, three specimens; *Regulus cristatus*, two specimens; *Troglodytes Carolinensis*, two specimens; *Sylvia coronata*, eleven specimens; *Turdus migratorius*, six specimens; *Fringilla tristis*, twenty-two specimens.

The *Fringilla tristis* and *Sylvia coronata* seemed wild and restless, as if preparing to migrate. Their numbers had also considerably diminished, and it is possible that they may not remain long enough to enable me to ascertain the process of their change of colour in spring.

March 6. Since I last visited the country there has been a fall of snow of about three inches in depth, remaining on the ground for twenty-four hours; an unusual occurrence in S. Carolina. This cold change brought back a number of birds that appeared to have left us for the season.

Obtained and examined the following species of birds. *Sylvia coronata*, twelve specimens. About one half of these (both males and females) had commenced moulting. The new feathers were of the bright colour which this bird assumes in summer plumage; the old remained stationary. *Fringilla Savanna*, seven specimens. These birds were receiving new feathers on various parts of their bodies; those on the head were all changing; under the chin, the ash coloured feathers of winter were replaced by those of pure white, the colour of summer. *Turdus migratorius*, two specimens. In one of these specimens a considerable number of young feathers were appearing along the breast, under the chin and on the head. *Troglodytes Carolinensis.* A row of new feathers along the sides.

No change was apparent in the following species. *Corvus ossifragus*, six specimens; *Corvus cristatus*, two specimens; *Fringilla tristis*, sixteen specimens; *Picus pubescens*, three specimens; *P. villosus*, two

specimens; *P. auratus*, two specimens; *Icterus Phœniceus*, eleven specimens, females; the males of the last species are found in separate flocks at this season, a few of the young males occasionally associate with the females.

After the above period, I was for a short time in Georgia, where, through the kindness of my friends, who furnished me with specimens, I was enabled to examine a number of species of birds. On my return to Charleston I resumed my inquiries into this subject, and through my own exertions and the aid of some of my young friends, had an opportunity of inspecting a considerable number of specimens, of various species, subject to a semi-annual change of colour. The result of examinations made on the 13th, 16th, 17th, 21st, 23d and 28th of March; on the 3d, 10th, 17th and 20th of April; and on the 4th and 5th of May, I will condense under a notice of each species, as the notes taken on these different occasions would swell this article to an unreasonable length.

Fringilla Pensylvanica, White Throated Sparrow. Of this species I was enabled to examine about thirty specimens, in addition to those in an aviary. The light ash colour under the chin is in every instance replaced by a fresh moult; the new feathers coming out pure white. This is the case in both sexes. The birds too appear to moult on every part of the body, some having the whole head covered with young feathers still sheathed; the same process is going on with others, on the breast; and in others, moulting first commences in spots on the back. Thus nature seems to leave one portion of the clothing as a covering to the bird, whilst it is renewing the rest; and the feathers of one part of the body are fully formed before moulting commences on other parts.

Fringilla Savanna, Savannah Finch; *Fringilla palustris*, Swamp Sparrow; *Fringilla melodia*, Song Sparrow; *Fringilla pusilla*, Field Sparrow. The same process was observed in these species. They all moulted extensively, but irregularly; and in many specimens every feather, except those in the wings and tail, appeared to be renewing.

Fringilla erythropthalma, Towhee Bunting. Of this species I received seven specimens. Two males had the whole head covered with new feathers; one other was moulting extensively on the back; not an

old feather was remaining on that part; and in another this process was going on among the feathers on the breast and sides. In the remainder there were a few young feathers, but no regular moult.

Sylvia petechia, Yellow Red-Poll Warbler. This species I was extremely anxious to examine, in reference to this subject. The difference of its plumage in winter and summer is as striking as that of *Sylvia coronata*. It however becomes yellow olive in spring, whilst the other becomes blue, streaked with black, with a yellow spot on its rump and crown. The *Sylvia petechia* has been described under two names, that of the above and *Sylvia palmarum*, by Bonaparte and Audubon; the latter recently acknowledged his error. I obtained of this species twenty-four specimens. Every individual was moulting extensively. The new feathers came out at once in summer dress, leaving not a shadow of doubt on my mind that this bird receives its bright colours from a change of feathers, and not from a change of colours in the old feathers.

Sylvia pensilis, Yellow Throated Warbler. This is one of the small number of the species of this large genus that breeds in Carolina. Its note was first heard on the 16th of March. Obtained, at various times, thirteen specimens. In every instance the whole of the yellow on the throat was replaced by young feathers just pushing forward, and in several individuals moulting was general over other parts of the body. The above observations apply equally to *Sylvia trichas*, Maryland Yellow Throat, of which I inspected about five specimens.

Fringilla tristis, American Goldfinch. This was one of the birds referred to by Mr Ord, as a proof of the correctness of his theory, that birds moult but once a year. Although this species is common in Carolina in winter, feeding on the seeds of the long moss (*Tillandsia usnoides*) that hangs in festoons from the limbs of our venerable live oaks (*Quercus virens*), and at a later period on the imported, but very common chick weed (*Alsina media*), it generally leaves us for the north early in March, and, no doubt, undergoes its changes of plumage in spring in the immediate vicinity of Philadelphia. This bird had left us for about two weeks, but was driven back to this vicinity in consequence of a succession of cold days; and from the 16th to the 22d of March I had an opportunity of obtaining forty specimens. On the

former day two or three individuals were brought to me in which moulting had commenced. From this period until every straggler appeared to have left us, on the 23d, I discovered that the process of moulting was advancing rapidly. It seemed to commence in the old males, extending itself to the females; and on my last examination not an individual of either sex was brought to me that was not in extensive moult. The young feathers on the head came out black; those on the rest of the body of a bright yellow. In the old feathers no change whatever had taken place. Mr Ord is correct when he states that this species is in full song in March; this was the case in all the individuals I observed; but he appears to have overlooked the opportunity of ascertaining that it was also in full moult. The theory that the song of birds is silenced in consequence of the exhausting process of moulting, is not calculated to bear the test of close examination. The *Fringilla tristis*, *Troglodytes ædon*, *Fringilla Pensylvanica*, *F. graminea*, *Sylvia pensilis*, and many others, were in full song, although they were moulting very extensively. This is also the case at the moment I am writing, in several species now in my aviary. It will probably be found that the vocal powers of birds are called forth by an increased development of the sexual organs, in the vivifying season of spring, and that their song is suspended in autumn, when these organs are sensibly diminished.

Psittacus leucocephalus, White Fronted Parrot. A bird of this species, now in the possession of my friend Dr Wilson of this city, was carefully examined on the 20th of March. It was in fine health, repeated several words, and made attempts at a song. We found it in extensive moult, and all who examined it were satisfied that it was receiving a full set of new feathers on every part of the body. This species exhibits a variety of colours, green, white, yellow, pink and red. The feathers came out apparently in the bright hues which the bird assumes when in perfect plumage. In pursuing my investigations on the change of plumage in birds, I have observed that old birds, moulting in spring, usually receive their bright colour at once, whilst many species, that moult in autumn, have these colours imparted to them by a gradual process.

Psittacus coccinocephalus, Scarlet Headed Parrot; *Psittacus purpu-*

reus, Purple Bellied Parrot. I have had in my possession, for several years past, a living bird of the first named species, and frequently seen one of the latter in the cage of a friend. Both species moult in summer, and again in the months of February and March. The moult, with the exception of the larger feathers in the tail and wings, was as general in spring as in autumn.

Emberiza oryzivora, Reed Bird. This species, which is so singular in its habits and changes, passes under different names in various parts of the country, referring either to its colour, food or song. In the eastern states it is usually called Bob-Link, from its notes bearing a fancied resemblance to those syllables. In New York I have heard the farmers call it Skunk Bird, in consequence of its black breast and sides and broad white streak on the back bearing a resemblance, in colour, to that animal (*Mephitis Americana*). In the middle states it is called Reed Bird, in consequence of its feeding on the seeds of that plant (*Zizania*); and in the southern states the Rice Bird, from the extensive depredations it commits on our rice fields; hence its specific name (*Oryzivora*).

In autumn, the male of this bird, as is well known, lays aside its black and white summer dress, not by a change of colour in the old feathers, but by a thorough moulting, extending even to the large feathers in the wings and tail. It now becomes of the plain colour of the female. In this dress it continues till March, when it gradually changes again, and in May is once more in full summer plumage. Mr Ord states, from personal observation, on birds confined in cages, that "during the time the male is undergoing this metamorphosis, there is no change of feathers, their colours being altogether the result of their organic secretions." I have no positive evidence to prove that there was any inaccuracy in his observations. These birds generally make their appearance in Carolina from the 1st to the 10th of May, when they have already attained full plumage. Having never kept them during winter and spring, I am obliged to consider the examinations of Mr Ord, in reference to this species, as conclusive. This will, then, show that the Rice Bird is an exception to the general rule, and that, whilst all our other known species that assume two distinct colours in a year moult in spring as well as in autumn, the Rice Bird is an in-

stance where a different process takes place. This, however, affords no proof of the truth of the assertion that all birds moult but once a year, since it is now certain that the majority of birds moult twice a year. I do not however consider it impossible, that even in regard to this species some mistake may have occurred. These changes progress silently and rapidly, and unless watched with great care, are effected without our observing the process. The males made their first appearance this year in our rice fields, in scattered flocks, on the 5th of May; and on that and the three following days I had an opportunity, through the politeness and attention of several planters, of examining fifty specimens. Nine-tenths of the birds were in full plumage, and there was no appearance of their having moulted; but in five or six specimens, where the black colour on the breast had not been fully restored, I perceived several places where rows of young feathers, still sheathed, existed in spots of an inch or two in extent. These feathers, instead of coming out yellowish brown, as is the case with the species when they moult in autumn, were black, narrowly edged on the points with brown. Whether the moult was accidental in these specimens, or whether it extends to every individual in the species, I had no means this spring of ascertaining; certain it is, that the young feathers perceptible on the specimens sent with this communication, do not undergo the process of the change from brown to black, which must be the case if the colours of spring are imparted without a fresh moult.

Sylvia æstiva, Blue-Eyed Yellow Warbler. This species, in autumn, is of a pale yellow colour, changing in spring to bright yellow, streaked on the breast with orange. It probably undergoes this change within the tropics. On the 27th of April I had an opportunity of examining eleven specimens; two of these were not in full plumage, and I observed that in one instance the whole head was covered with new feathers, and in another the young feathers on the back had recently been produced, and were still enclosed in a tube.

Fringilla cyanea, Indigo Bird. This is a rather rare species in the maritime districts of Carolina, and breeds but sparingly in these parts. On the 3d of May I obtained three male Indigo Birds. They were in full song, and I was enabled to discover them by their notes. One of the birds was in perfect plumage, and I could observe no evidences of a

moult; the other two were mottled, and the points of the feathers were edged with brown. They were receiving new feathers extensively on every part of their bodies; one of the birds would probably have been in full plumage in a week, the other was less advanced, and would have required a longer time. Whether these were young birds receiving their bright colours for the first time, or old birds renewing their colours by a fresh moult, I could not ascertain.

The arguments of Dr Flemming (vol. II., p. 26, 27) in favour of his theory that a spring moult is unnecessary to a change of colour in feathers, as confirmed by the examination of Captain Cartwright on the Ptarmagin (*Tetrao lagopus*) of Labrador, is very far from being satisfactory to my mind; on the contrary, it appears to me that Cartwright's own notes, taken on the spot, ought to have caused the Doctor to have hesitated, before he adopted, so confidently, a theory which may yet be discovered, on a more careful examination, to be wholly founded in error. The following is an extract from the Captain's Journal (see Transactions, On the Coast of Labrador, vol. I., p. 278): "When I was in England, Mr Banks [Sir Joseph Banks], Dr Solander, and several other naturalists, having inquired of me respecting the manner of these birds changing colour, I took particular notice of those I killed, and can aver for a fact, that they get at this time of the year (September 28) a very large addition of feathers, all of which are white, and that the coloured feathers at the same time change to white. In spring, most of the white feathers drop off, and are succeeded by coloured ones, or, I believe all the white feathers drop off, and they get an entire new set. At the two seasons they change very differently; in the spring beginning at the neck, and spreading from thence; now they begin at the belly, and end at the neck." Captain Cartwright here asserts that the Ptarmagin, in autumn, receives a very large addition of white feathers, but that the coloured feathers are changed to white. I perceive no difficulty in explaining this autumnal change. Presuming that the birds moulted in the middle of August, as is the case in Labrador, some of the feathers would not come out pure white, but would gradually become so, as is the case with other birds I have mentioned, and they would thus, for a time, retain a mottled appearance. The summer moult in birds extends over the whole body, even to the wing and tail

feathers, in every species I have examined, and I presume that the Ptarmagin does not form an exception. The only point of difficulty lies in the spring moulting, and in this Captain Cartwright is pretty explicit. He states, with some hesitation, his belief, from an examination of many specimens, that "all the feathers, in spring, drop off." There could have been no difficulty in ascertaining this fact, from the manner in which young feathers are sheathed during the process of moulting. Here, then, we have another well attested proof of a double moult in those species of birds that are subject to a semi-annual change of colour.

Before concluding my remarks on land birds, it may be necessary to state how far I have found my observations to apply, in regard to a second moult in birds in general. I have examined no species in which an individual was not occasionally found, that was not moulting sparingly during spring. This may, however, in some species, have been accidental. The Mocking Bird, Blue Bird, Cardinal Grosbeak, Loggerhead Shrike (*Lanius ludovicianus*), and some others, I have reason to believe, do not moult to any extent in spring, although a considerable number of feathers drop off, which are not replaced; and yet in many other species of the genera *Turdus* and *Fringilla*, even where no very great change of colour occurred, the moult extended to every part of the body; whilst the Mocking Bird and the Brown Thrush (*Turdus ferrugineus*) did not appear to moult. The Solitary Thrush (*Turdus minor*), which loses nearly all its spots on the breast in spring, seemed, on the 29th of March, to have acquired a full set of young feathers on the breast.

Although in many species the moult appeared to be complete in other respects, yet in but two species, the Savannah Finch and Swamp Sparrow, did I discover that the scapulars and tail feathers were moulted; these are stronger and firmer, and as far as my observations have gone, seem, in most of the species, to be shed but once a year; this will not surprise us, when we take into consideration the diversity in the operations of nature in other animals. The horse, for instance, sheds his hair on every part of the body at least once a year, and yet the hairs in the mane and tail continue to grow during the life of the animal. On the other hand, the thinner and lighter hairs of animals, and feathers

of birds, are frequently removed, and easily replaced. The feathers on the breast of female Canary Birds, and most other species that I have noticed, drop off during incubation, and are successively replaced during the season, at every time they recommence building their nests.

On the spring moulting of water birds the following information has been collected.

In the spring of 1825 a specimen of our beautiful Fresh Water Rail (*Rallus elegans*) was sent me from the country. It was so completely in moult, that it could not be preserved as a specimen. The young feathers came out in their full brightness.

On the 7th of April 1835 I examined several Shearwaters (*Rhincops nigra*). About one half of the birds were in the moult; the remainder still retained their winter dress and colours.

On the 20th of April 1836 I procured three males of the Semi-palmated Snipe (*Totanus semipalmatus*). They were changing from winter to summer plumage, and were moulting very extensively.

Early in the month of May 1833 I saw a large string of Black Bellied Plovers (*Charadrius helveticus*) in the markets of New York, and being desirous of obtaining some specimens for the cabinet, as this bird has not arrived at full plumage in its spring passage along the sea shore of Carolina, I found so many of them in fresh moult, and their young feathers still sheathed, that it was difficult to find specimens suited to my purpose.

In September 1835 a Turnstone (*Strepsilas interpres*) was sent me by a friend. It had been wounded and captured by his son, whilst in its plain autumnal plumage. I entrusted it to a lady who fed it on moistened corn meal, and on bread soaked in milk. It survived the winter, and was in fine health on the following April, when it shed its winter dress, and the new feathers, although not perfectly bright at first, became so in three weeks.

March 20th, 1837, saw about two dozen of the Ruddy Duck (*Fuligula rubida*) in the Charleston market. All that I examined were males. They were receiving their ruddy colour of spring, and were moulting very extensively.

March 21st, examined a Black Headed Gull (*Larus atricilla*). On every part of the head the ash coloured feathers were becoming re-

placed by young ones, still sheathed; these were of a dark lead colour, appearing in some lights quite black.

March 1834, received from Boston specimens of the Herring Gull (*Larus argentatus*), together with a number of northern species, which are now lying before me. In the majority of them, moulting had progressed to a considerable extent. Mr Ord conceives Montagu, who had made similar observations on this species, as "labouring under the influence of a theory," when he recorded the result of his investigations. The correctness of Montagu's assertions has been verified by my own observations.

Mr Ord has, moreover, doubted the accuracy of Montagu's observations on the changes of plumage in a Black Stork, taken in England. The latter gentleman stated that this bird continued very gradually to moult during summer and winter; that in the month of March, the violet and purple feathers appeared on the back, and that the whole upper parts had nearly assumed this beautiful plumage by the 1st of April. He supposes that it could not have moulted, although Montagu asserts that to be the fact, and considers this statement of Montagu as "affording one of the most apposite illustrations of the fact of a change of colour in mature plumage, that could well be desired." I have not been able to regard it in this light. Admitting that all the species of Storks and Herons moult but once a year, of which we have no certainty, it does not appear difficult to account for the slow pace with which this individual assumed its bright colours. It will be recollected that it was a foreigner, retained in captivity during winter, in the moist, cold climate of England. Had it been left at liberty to pursue its migrations to Africa, where this species hyemates, it would probably have sooner attained full plumage. It is, moreover, highly probable that this stork was changing from the young to the adult plumage; in this case the process was similar to that of the *Plotus anhinga*, referred to in a former part of this paper, and of the Blue Grosbeak, now in my possession; the latter having been gradually moulting and receiving its bright colours during the winter and spring. Young birds always shed and renew their feathers more slowly and irregularly than the old; and in this instance, where we have a process so similar in other species, we cannot avoid giving credence to the decla-

rations of a naturalist, who was an eye witness of the facts he describes, in preference to the mere conjectures of another.

Although it has been more my intention in this paper to record the facts which I have been able to collect on this subject, than to frame a new theory, or endeavour to restore an exploded one; yet it has often occurred to me, that the advocates of the two opposite theories have run into extremes, in consequence of the adherence of each, with too much pertinacity, to a preconceived opinion. Hence Montagu, having ascertained that some birds are subject to two moultings in a year, conceived that this was the only mode by which the colours of feathers were changed, asserting that "he had no conception of the feathers themselves changing colour." On the other hand, Dr Flemming, and those of his school, including the Rev. Mr Whitear and Mr Ord (the latter advanced a step beyond all the rest, in stating as his opinion that "all birds moult but once a year"), having observed that the colours in feathers change in the early stage of their growth, came to the conclusion that the same process must always be carried on in the old feathers, and that a fresh moult being unnecessary, would consequently not take place.

The observations which I have made thus far, have led me to conceive that the truth lies between these two extremes. Although my investigations were not extended to as great a number of species as I could have wished, or repeated through a succession of seasons, it has, notwithstanding, been very apparent to my mind, that young feathers frequently change colour, particularly in autumn; but that in those cases where there is a semi-annual change of colours, there is in all, or nearly all the species, a semi-annual moult. That a much greater number of species change their feathers twice a year than is usually supposed, and that our inquiries must be directed to individual species, rather than to genera, since in the same genus one species is subject to a double moult, whilst the others moult but once a year.

4. Having now seen in what manner nature performs her operations in effecting the changes in the plumage of birds, I proceed to inquire whether the same laws may be applied to those variations in colour to which the hair of quadrupeds is subject. The vascular bulbs in which the roots of the hairs are inserted, bear an analogy to the bulbs which

contain the rudiments or sheaths of the feathers. The hair, like feathers, is nourished and receives its colour from the secretions of the animal, and is exposed to the same sun, air and moisture. It continues to grow during a certain period, and drops off when it has arrived to full maturity, as do the feathers from the bird, and the leaf from the tree. There is also a striking similarity between the covering of birds and quadrupeds, in the changes to which they are subject, from the young to the adult state, and the mutations of others during the different periods of the year. As the majority of the species of young birds are of the colour of their parents, so are the young of quadrupeds. Some young birds remain for a length of time of a very different colour from that which they assume when they arrive at maturity, as is the case with some of the species of our *Fringillæ*, *Ardeæ*, and other genera. This is also apparent in some of our quadrupeds. The young of the Deer and Cougar (*Felis cougar*), for instance, are striped or spotted with white and red, whilst their progenitors are of a uniform dun or fawn colour. Some birds are disguised in two such opposite sets of colours, in the course of the year, that the gay visiter of spring can scarcely be recognised under his homely dress in autumn. So also our Ermine, and two, at least, of our species of Hares, are brown during six months of the year, and of a snowy white pelage during the other six months. Bearing so strong a similarity in many other particulars, we are led to believe that in the process of moulting, or shedding of the hair, this harmony of nature still continues to prevail.

Here, however, the same difference of opinion has obtained among naturalists. Probably much has been written on the subject in European journals which has not fallen under my observation. Dr Flemming (see Philosophy of Zoology, vol. II., p. 24) advances an opinion, the result of personal observations, that "the change of colour in those animals which become white in winter, is effected, not by a renewal of the hair, but by a change in the colour of the secretions of the *rete mucosum*, by which the hair is nourished, or perhaps by that secretion of the colouring matter being diminished, or totally suspended." This theory, as far as I have been able to ascertain, has generally been adopted by physiologists. I have also noticed the remarks of Dr Richardson, on the changes in the colour of the American Hare (*Lepus America-*

nus), in his Fauna Boreali-Americana, where he expresses a belief, founded on examination of many specimens, that "the change to the winter dress is produced, not by the shedding of its hair, but by a lengthening and blanching of the summer fur."

From these opinions I am obliged to dissent, for the reasons already advanced, and the evidence I shall proceed to adduce.

There are but four quadrupeds yet found in our country, the Polar Hare, Northern and Prairie Hares (*Lepus pampestris*, Bach.), and the Ermine, in which these mutations are very striking. Let us now examine this peculiarity in some of these, and one or two other of our quadrupeds, and we shall be able to judge how far this theory is calculated to maintain its ground among naturalists.

Lepus glacialis, Polar Hare. I have had no other opportunity of becoming acquainted with the changes of colour to which this fine Hare is subject, than that afforded by a specimen which was kindly presented me by Audubon; but this, in itself, affords sufficient evidence on which an opinion may be grounded with safety. The animal was purchased in the flesh by our distinguished American ornithologist, from an Indian, at Newfoundland, on the 15th of August 1833. At that early season, then, in the cold regions of the north, this change from its summer to winter colours takes place. The specimen before me is in that interesting stage when the summer fur had commenced dropping off, and the white winter dress was fast advancing to resume its place. This, as far as has been ascertained, is the only specimen, in summer colour, that exists in any collection. The specimens brought home by Dr Richardson, Captain Parry, and the other adventurous explorers of our polar regions were all in the white pelage of winter. Its summer colour is grayish brown above, with conspicuously black ears. In winter the hairs all become snowy white, even to the roots. In the specimen now before me there is a large spot, nearly a hand's breadth, of pure white on the back, extending nearly to the insertion of the tail; three or four white spots, of about an inch in diameter, also exist on the sides. The hairs forming these spots are shorter than the surrounding fur; a few longer hairs of the summer dress are still interspersed, which had not yet dropped off. The short, white hairs are, in several places, seen pushing forward, whilst the sur-

rounding ones seem to have been thinning and falling. This, then, is undoubtedly the process of the change of colour in this large and interesting species.

Let us now examine how far other quadrupeds, subject to the same mutations, differ from the above, in changing from the brown dress of summer to their white clothing of winter, so much in unison with the snows around them, and which, by concealing them from the view of a host of enemies, is often the cause of their preservation.

Lepus Virginianus, Virginian or Northern Hare. This Hare, which is an exclusively northern species, and not a resident of Virginia, seems to have been not only improperly named, but very imperfectly described by our naturalists. The habits, however, of quadrupeds and birds are, in general, only alluded to in this article, so far as it may enable us to throw some light on the subject now under discussion. I possessed favourable opportunities of witnessing the semi-annual changes of colour to which the *Lepus Virginianus* is subject; having in early life, whilst residing in the state of New York, had several of this species in a state of domestication, where they produced and reared their young. The notes made twenty-two years ago were mislaid, but I have a pretty distinct recollection that the following was the process. The animal shed its white fur in spring. The hair, although yellowish, and soiled by age and exposure, indicated no appearance of a change of colour from white to brown, before dropping off. The new hairs came out reddish brown, in which dress it continued till autumn, when the summer fur gradually dropped off, and the hairs composing the winter pelage became visible through the rest. In four weeks the summer dress had entirely disappeared. The new hairs did not, however, appear pure white, but of a light iron gray colour, mixed with occasional white and black hairs. Gradually the hair grew longer, and seemed to become whiter, till, in the course of a few more weeks, the change was complete. In this case, then, nature seems to pursue the same process as in effecting the changes of colour in some birds, by a gradual blanching after the moult. It will be observed that in this species the hairs are only white, although broadly so at the points, and not throughout their whole extent, as in the *Lepus glacialis*.

Lepus Americanus, American Hare. The changes of this Hare I

have also had an opportunity of witnessing, in a warren. It cast its hair in spring, and became of a yellowish brown colour. In the autumn it again commenced shedding. Whether all of the hair dropped off or not I cannot say with positive certainty; new hairs, however, were continually adding; the points of these were white, as they came forward. In the old hairs I could perceive no change. There were many black ones interspersed, but whether these were of a new, or of a former growth, I had no means of ascertaining. I felt confident, however, that the light colour of winter was produced by the new hairs it had received in autumn. This Hare has, by some of our authors, been described as becoming white in winter. It should be observed, however, that the points of the hairs are so narrowly tipped with white, and the markings of brown and cinereous still so visible, that it can in no part of the northern United States be described as white.

Lepus palustris, Marsh Hare. For a description of this species, see Journal of the Academy of Natural Sciences, vol. VII., and an engraving in Audubon's Birds of America, vol. IV., pl. 366. This singular and almost aquatic species sheds its hair twice a year, as I have had an opportunity of ascertaining from having had one in confinement. Although much hair dropped off in autumn, I found it, however, difficult to satisfy myself that this change was as thorough as that in the spring. In the beginning of winter, the points of its hair, instead of growing whiter, as in the American Hare, grow darker, until they have become nearly black, thus proving that the effort of nature is to change the colours from brown to pure white, in some species, and to black in others.

Mustela erminea,* The Ermine. This animal, usually called

* Godman has stated, on the authority of Charles L. Bonaparte (Nat. Hist. vol. I., p. 193), that our common Weasel (*M. vulgaris*) has been proved to be the Ermine in summer pelage. I had an opportunity of ascertaining, from actual examination, that there is some inaccuracy in this statement. I preserved several of both species in the same cage, during a winter, in the northern part of New York. The Ermines became white in autumn, although some of them were still young, and not more than two-thirds grown. The other species retained through the winter their brown colour. Richardson states that the latter species also becomes white in high northern latitudes. This is certainly not the case in lat. 45°. There is another peculiarity which I had occasion to notice. Whilst the Ermine is much abroad during winter, its footprints appearing every where on the snow, the common Weasel is rarely, if at all, seen during that period. A large brood that had made the root of a tree their residence in

Weasel in the northern states, is brown during six months of the year, and in winter becomes white, with the exception of the tip of its tail, which is black.

I was not aware, until this paper had been nearly written, that any one had published an account of a particular examination of the Ermine during those periods when it is subject to change its colour. I am indebted to my friend Professor Moultrie, for a reference to a paragraph in vol. II., p. 24, of Flemming's Philosophy of Zoology, where the following remarks occur.

"The appearances exhibited by a specimen now before us are more satisfactory and convincing. It was shot on the 9th of May 1814, in a garb intermediate between its summer and winter dress. In the belly, and all the under parts, the white colour had nearly disappeared, in exchange for the primrose yellow, the ordinary tinge of these parts in summer. The upper parts had not fully acquired their ordinary summer colour, which is a deep yellowish brown. There were still several white spots, and not a few with a tinge of yellow. Upon examining those white and yellow spots, not a trace of interspersed, new, short, brown hair could be discovered. This would certainly not have been the case if the change of colour is effected by a change of fur. Besides, whilst some parts of the fur on the back had acquired the proper colour, even in those parts, numerous hairs could be observed of a wax yellow, and in all the intermediate stages, from yellowish brown, through yellow, to white.

"These observations leave little room to doubt that the change of colour takes place in the old hair, and that the change from white to brown passes through yellow. If this conclusion is not admitted, then we must suppose that this animal casts its hair at least seven times in the year. In spring it must produce primrose-yellow hair; then hair of a wax yellow; and lastly of a yellowish brown. The same process must be gone through in autumn, only reversed, with the addition of

winter, were seen around this retreat almost every day during autumn, till the ground became covered with snow. They could now no longer be traced, till the snows began to melt, when their holes were again opened, and they were seen as usual. Our *Mustela vulgaris* ought to be carefully compared with that of Europe, which goes under the same name.

a suit of white. The absurdity of this exposition is too apparent to be further exposed."

This examination, and the arguments which have been drawn from it by so able a naturalist as Dr Flemming, would appear, at first sight, to be conclusive. But, on a closer investigation of the subject, and a more careful inquiry into the operations of nature, doubts will arise, both as to the accuracy of his investigations and the soundness of his theory. The Doctor's observations were made, it will be recollected, on the 9th of May, the very period when the Ermine is shedding its winter fur. A sensible writer, in Rees's Cyclopœdia, on the article Hair, makes the following remarks. "As the pulp is intended for the nutrition of the hair, it is found to extend only to that portion of the hair which is in a state of growth; and in those which are deciduous, or are cast at particular seasons of the year, such as the hairs covering the bodies of quadrupeds, the pulp becomes entirely obliterated, before the period of shedding the hair, and its root is converted into a solid pointed mass." If, then, the change, as Dr Flemming contends, had taken place in the old hair, so much in opposition to the views of the writer above quoted, what must have been the process? In the summer, after it had cast its old hair, it must have acquired a coat of wax yellow, which, in process of time, changed to yellowish brown; then in autumn, this same hair would have turned white; now comes the spring, and even in this advanced age of the hair, it once more turns yellow, and then yellowish brown. No harlequin assumes greater changes; and it may be inquired whether the Doctor's theory is not even more absurd than that which he assails with such apparently strong facts and powerful arguments.

It has, however, appeared to me, that the changes in colour to which the Ermine is subject, have not been closely observed, or accurately described. Admitting that this quadruped sheds its hair in spring and autumn, which I hope to prove is the fact, it will be discovered that in this respect the change is not more remarkable than that produced on several other species of quadrupeds, and on many birds; among the latter, as instances, we may mention the Yellow Crowned Warbler, Rice Bird and American Goldfinch.

At an early period of life I had an opportunity of witnessing the

change in the pelage of the Ermine, from white to brown. The following is the only memorandum of this occurrence that I can find in my diary. "April 17, 1814. My ermine has become a little tamer, but all its beautiful white hairs are dropping out, and it begins to look like a brown Weasel." I have endeavoured in vain to conjecture the possibility of my having in some way been deceived in my observations. The notes were made, I acknowledge, when I had no knowledge of natural history, and had read no work on the subject; but, on the other hand, I had no favourite theory to support. That the Ermine shed its hair at that early period, I feel confident, from another circumstance. I was in the habit of combing out its white hairs, which were continually falling off, and on one of these occasions it inflicted a wound with its teeth on my hand. Admitting, then, that my observations were correct, and they happened, by a singular coincidence of circumstances, to be made the very year, and within a few weeks of the time when Dr Flemming examined the same species, it will not be difficult to ascertain in what manner he had been deceived. The new hair, both in the Ermine and the Northern and Polar Hares, comes out iu spots, sometimes only of a few inches in diameter. It grows so rapidly that it appears to attain its full length in less than a week. In the meantime the surrounding hair may not yet have commenced shedding, and remains of its former colour. This may account for the white spots on the specimen examined by Dr Flemming, which, in all probability, was a prepared skin. These parts of the animal had not yet moulted, and therefore had undergone no change. With regard to the wax-coloured hair of which he speaks, they must have been the old, faded and soiled hairs of winter, as any one may easily ascertain by examining the stuffed skin of an Ermine. The white pelage soon assumes a yellowish cast.

In the autumn of 1823 I had an opportunity of witnessing the change of the Ermine from brown to its snowy mantle of winter. It had been brought to Charleston by an itinerant showman. The cage, I observed, was every where strewed over with brown hairs that had dropped off. The young hairs were white in appearance, but whether purely so at once, or became more blanched as the season advanced, I had no means of ascertaining, as the Ermine was wild and vicious, and

made formidable opposition to an examination. The man raised his price upon it as soon as he ascertained that it was becoming white.

If I were not deceived in my observations, it will, then, appear that the Ermine has only two, instead of seven colours in a year. In the spring it casts off its white coat, and becomes brown; the hairs may be a little lighter at first than they become a week after, as is the case with those of other quadrupeds. In autumn these yellowish brown hairs drop off, and are replaced by the white fur of winter. In investigating the changes to which this animal, which so seldom comes under the inspection of the naturalist, is subject, we may derive some information from this process of nature in regard to species with which we are more familiar. If the old hair of the Ermine changes from white to brown, in spring, previous to its shedding, we may presume that a similar process will be observed in the Virginia Deer. A pair of the latter animals are now shedding their hair under my daily inspection. The long, gray hairs of winter are continually dropping off; they have not undergone the slightest change. Reasoning from analogy, on the principle of Dr Flemming, these ought to become red, the colour of the hair of the deer in summer. This, however, is not the case in this species, nor in any other with which I am acquainted.

Although I feel a tolerable degree of certainty that I was not deceived in my observations on the Ermine, yet, as they were not made in reference to this mooted point, I have a strong desire to have the subject further investigated by some scientific naturalist.*

* The Ermine is easily captured in a box trap, and can be fed on any kind of fresh meat, although it prefers birds and mice. The old, which I had at different times in confinement, although they did not seem to suffer in their health, never became reconciled to captivity. One of this species, however, taken when about five months old, appeared in a few weeks to have lost all its wildness and ferocity, leaving the cage at my call, following me about my study, and taking food from my hand. It was occasionally let loose in the outhouses and barn, where it made fearful havoc among the rats and mice. I observed it did not seize a rat, as this species is wont to do when it attacks poultry, by the neck, but pounced upon it suddenly, sinking its teeth into the skull, and then leaping off a few feet (as if to avoid being bitten), leaving it to struggle and die, without any further effort on the part of its enemy. When it had killed a considerable number, it was in the habit of dragging them on a heap, and covering them with straw. On these occasions it showed some reluctance to return to its place of confinement. After having tasted the sweets of liberty, it would often conceal itself for a day or two in the neighbourhood of its prey, and the calls of hunger alone would bring it back again to the house. On an occasion of this kind it disappeared, and it was supposed had been killed

How far other quadrupeds, in a state of nature, are subject to this biennial shedding of the hair, is an inquiry which we must make, not from books, but from a careful examination of the different species. The generally received opinion of quadrupeds shedding but once in a year, should be more carefully examined, in regard to some of the species, before it is fully adopted. The rule may admit of more exceptions than is generally supposed. The Deer (*Cervus Virginianus*) sheds its hair in Carolina in the month of April, and sometimes earlier. These, till autumn, are of a reddish colour, when the animal assumes a bluish dress, gradually fading to gray. In what manner is this change produced? The Harvest Mouse (*Mus leucophus*, Raff.) is of a fawn colour above in summer, and bluish ash in winter. The black variety of the common Gray Squirrel (incorrectly referred to *Sciurus Carolinensis*) is much more brilliantly black in winter than in summer. Can these old and faded hairs receive an additional blackness and brightness as the cold weather approaches? The fur of quadrupeds is thicker and warmer in winter than in summer, and if they do not shed their hair, they must at last receive an additional covering in autumn; and the same effort of nature which can produce a part, may restore the whole. Possibly it may, on a more careful examination, be found that the new hairs received by these and other species in autumn, may so predominate as to conceal in part the rest. I can easily conceive that hairs may become redder, under the influence of a burning sun; but that they should, after six months, again change and become plumbeous, cannot be credited, without a minute examination of facts. Our domesticated animals can afford no criterion by which we may judge,

by a dog. It was not again observed by the family for six months. On my return from a college vacation, I once more occupied my former chamber. During the night I found some small animal creeping among the blankets, and on procuring a light, ascertained to my great surprise and pleasure, that my long lost pet had come, as if to greet my return. It had, in the meantime, changed its colour, and was beautifully white. How long it had kept possession of the vacant chamber is unknown. I perceived it had found egress through a hole in the hearth. It was from this time no longer placed in confinement, but permitted to take its own course, as it had committed no depredations on the poultry. It attached itself to the premises for about two years afterwards, having formed a large nest of straw under the covering of a globe. In this situation it would sometimes lie for two or three days, as if dozing, and disinclined to take exercise; at other times it was absent for several days in succession. It finally disappeared, from what cause I was never able to ascertain.

with certainty, of all other quadrupeds. The Horse, although it sheds its coat freely in spring, is irregularly losing and restoring its hair throughout the year. A change in food or in health is continually accelerating or retarding this process.

If some apology be requisite for these somewhat desultory remarks, and for having entered so much into detail, it may be offered, in defence, that the subject on which it treats, although apparently trifling and unimportant, leads to many inquiries in philosophy and in natural science. In investigating the changes from brown to white, in some quadrupeds, we are led to inquire into the cause of this change. If it be answered that it is the effect of cold, the question will naturally arise, Why does not cold produce the same effect on other animals? Why do not the Fox, the Raccoon and the Bear, residing in the same neighbourhood, also become white in winter? Besides, the change commences in the heat of summer. The Polar Hare, brought by Audubon, was undergoing the change on the 15th of August. The Ermine was becoming white in the middle of October, in Carolina, when the weather was still very warm. The emperor of China is said to have preserved the *Lepus variabilis* in the warmer parts of his dominions, and even there it was subject to become white. This colour, then, rather anticipates than succeeds cold weather, and it would seem as if there was some constitutional predisposition of the animal to the change. A further examination into these mutations of colour to which birds are subject, may extend our knowledge of physiology in regard to the development and growth of feathers, and the process by which their colours are imparted. Although it is generally admitted that there is no circulation in hair or feathers, still this point does not appear to be fully determined. Bichat* supposed that there was a species of circulation in the interior substance of the hair, by which he endeavoured to explain the changes of colour. This opinion, however, has been contradicted by modern physiologists, who suppose the hairs to be constituted by a colourless, transparent epidermic or horny sheath, filled with a species of coloured pulp; and they contend that the hair

* Anatomie Générale, Tom. II., p. 788.

is not, properly speaking, caniculated, the colouring matter being deposited by the papilla at the same time as the epidermic sheath.* The chemical composition of feathers is believed to be nearly the same as that of hair, nails, &c. consisting principally of inspissated albumen, united with small portions of gelatine and animal oil; and it is a subject of inquiry what chemical action takes place, which imparts colours not only to the shafts of the quill, but to the barbs, and even the minute barbules attached to these barbs. Are these changes in colour effected by the action of the external atmosphere, or by a vital operation? As the air contained in the feathers is exposed to the influence of the vascular pulp, may it not in this way produce a chemical action on the colour of the feathers? Some birds certainly moult twice a year, with the exception of their wing and tail feathers, which, in most species, are only cast annually. As the latter are longer in coming to maturity, may not colours be imparted to them more slowly, and may not this account for the changes of colour which are progressively taking place in the bars on the tails of Hawks and other species?

These inquiries may be also attended with beneficial results to the science of ornithology, in enabling us to discriminate the true from merely nominal species. By a little attention to this subject, Wilson was enabled to expunge from our nomenclature of birds many species which Catesby, Edwards, Pennant, Latham and others had multiplied to a great extent, and to extricate the science from difficulties which were continually leading the student of nature into infinite doubts and perplexities. Through this mean also, Bonaparte, Nuttall and Audubon corrected some of the errors into which their predecessors, from a want of opportunity for a fuller investigation of the subject, had fallen. The work is not yet completed. By a further inquiry into the changes in plumage to which birds are subject, species that are now supposed distinct, may be found to be identical. Many new species of Gulls, that have been multiplying in Europe and America, may prove to be the young, or the winter plumage of species that have long since had a name.† The long disputed, often rejected, and as often readmitted

* Cruveilhier, Anatomie Descriptif, Tom. III., p. 420.

† This genus requires a more careful revision. It will be found, on an attentive examination of the changes of plumage to which the species are subject, and on a comparison with

Winter Hawk (*Falco hyemalis*) might, on being preserved in confinement for a single year, be placed where he ought to be; probably by the side of the Red Shouldered Hawk (*Falco lineatus*). The Connecticut Warbler (*Sylvia agilis*) might claim identity with the once rejected, but now admitted, Mourning Warbler (*Sylvia Philadelphia*). The Autumnal Warbler (*Sylvia autumnalis*), that is abundant in autumn, but has been sought for in vain in spring, might then perhaps find a father in the Black Poll Warbler (*Sylvia striata*). Roscoe's Yellow Throat of Audubon might come to claim relationship with the *Sylvia trichas*; his *Sylvia Childrenii* might be found to be only another name for *Sylvia æstiva*, and his *Sylvia Vigorsii* for *Sylvia pinus*. The difficulty in preserving several of the genera of birds in confinement, for the purpose of studying their habits, has been considerably overrated. Granivorous birds, as it is well known, may be fed on seeds, and in this manner thousands are annually brought from Africa and the East Indies. Warblers, Fly-Catchers, and even Swallows, the most difficult (except the Humming Birds) to preserve, are now kept in cages throughout the year in London, Paris, and especially at Rome. They are fed on vermicelli, and occasionally on chopped meat. A regular temperature in the room where they are confined is preserved throughout the winter. The various species of Ducks, which are easily caught in traps or nets, soon accustom themselves to the food of the poultry yard, and become domesticated. By this means several of our wild species may be made to minister to our pleasures and comforts. The Mergansers, Gulls, Lestris, Procellarias, Anhingas and Cormorants may be fed on fish, their natural food. The Sandpipers, and as in the instance of the Turnstone already noticed, may be preserved by being fed on various kinds of soft food, easily to be procured. I have seen the

those of the eastern continent, that our species are unnecessarily multiplied, and that some that are described as identical with those of Europe, are distinct. *Larus minutus*, *Larus canus* and *Larus fuscus*, as given in Bonaparte's Synopsis, will probably be found not to exist in the United States. Our species, which has gone under the name of *Larus minutus*, is, I am inclined to believe, the *Larus Bonapartii* of Richardson; the *Larus capistratus*, the young of *Larus Bonapartii*. The *Larus argentatoides* the young of *Larus marinus*; and the species which our authors have considered as *Larus Canus*, is probably the immature bird of *Larus zonorhynchus* of Swainson.

Ruff of Europe (*Tringa pugnax*)* for sale in a cage in the Charleston market. It was fed on soaked ship biscuit, on its passage from Liverpool.

On revising this article, which has insensibly grown upon me as I proceeded, and which has extended to a length not originally anticipated, it has occurred to me that it might be construed, by some, as evidencing a disposition to cavil at the writings, and undervalue the labours of the able and estimable naturalists of our country. I should reproach myself with ingratitude, could I for a moment conceive that I had been influenced by such unworthy motives. The number of American naturalists has been exceedingly limited; their labours have been great, and poorly requited, in a pecuniary point of view, or in what they regard of most value, fame. We are indebted to them for

* This species has recently been added to our ornithology by Mr Nuttall, in consequence of a fine specimen having been obtained in the neighbourhood of New York. I doubt whether we have a right to claim it as American. Birds well known on the eastern continent, unless they exist in high northern latitudes, ought to be admitted with great caution into our Fauna. The European Partridge has been killed in the middle states; no doubt it had escaped from a cage. I obtained, some miles from Charleston, a male Chaffinch (*Fringilla cœlebs*), in full song, and afterwards saw its imported mate in a cage in the market. I had for some years in possession a European Turtle Dove (*Columba turtur*), which had escaped from confinement, and, it was afterwards ascertained, had flown on board of a vessel at sea, three hundred miles from the coast of France; and I received two years since, from my friend Mr Nicholson, a European Kestrel (*Falco tinnunculus*), which had alighted on the rigging of the ship, several days' sail from Liverpool, on his passage to America. Surely these species, brought to our country by force or accident, cannot be claimed as belonging to us. It will be a source of regret, if, in this respect, we are led to imitate the example of European ornithologists, who, in order to swell their list of birds, publish every foreign species escaped from a cage, or driven on their coast by a tempest.

The admission of species from specimens obtained from museums, on doubtful authority, is a still greater evil. In this way Mr Nuttall, who exercised so much knowledge and caution in his botanical works, has, in his ornithology, admitted species to which I am inclined to think we have but a doubtful claim. His Reed Bunting (*Emberiza schœniclus*) of Europe, for instance, is given on the authority of specimens presented to Audubon by a keeper of a museum, who stated their having been obtained at Harrisburg, Pennsylvania. I had an opportunity of examining these specimens; the materials with which they were filled, and the English holly bush on which they were fastened, betrayed evidences of their having come from across the Atlantic, ready stuffed and perched. Mr Audubon finally came to the same conclusion. It is difficult to expunge a species once admitted into books. The Willow Wren of Catesby, and the little Spotted Grey Sparrow of Latham, have caused many a poor ornithologist to wear out his shoes in a fruitless search. It might be advisable to act towards these perplexing species as is done in some colleges, where a name, if not answered to after having been called a certain number of times, is stricken from the rolls.

those exertions and sacrifices which have removed the obstructions in the paths of science, and have tended to interest, enlighten and instruct us. Their errors were the results of circumstances beyond their control; and the best service we can render them, or their memories, is to supply the materials which will render their works immortal. In our researches after truth, in science, where the wisest are liable to err, it is not only admissible, but a duty which we owe to mankind, to point out, in the language of courtesy and respect, the mistakes into which we conceive our superiors to have fallen. Our distinguished naturalists we should claim as a portion of our country's choicest wealth, and in them, as in the railroads which are spreading comfort and sociality over every quarter of our land, we should all strive to have an interest and hold a share, in order that we, in our turn, may pass along with greater safety and comfort.

Specimens elucidating some of the Points treated of in this Communication.

No. 1. *Lepus Americanus*; obtained on the 20th of October. Examined the animal in the flesh. It was shedding its hair. On the back and a spot on each of the sides, the reddish summer fur still remains. On the sides and near the tail the lighter winter fur is visible. The difference of colour is sufficiently apparent.

No. 2. *Fringilla Savanna*; 23d of February. Moulting around the throat, and extensively on the neck, breast and back. The feathers on the breast coming forward nearly white.

No. 3, 4. *F. Savanna*; May 4. The fresh moulting nearly completed, and the summer colours restored. In these specimens the moult had extended to the larger feathers in the tail and wings.

No. 5. *Fringilla tristis*, male; 16th of March. The summer feathers appearing bright yellow on the breast. Other specimens had the feathers coming out pure black on the crown.

No. 6, 7, 8, 9. *Fringilla Pensylvanica*, White Throated Sparrow; in various stages of moulting. Obtained in March and April.

No. 10. *Bombycilla Carolinensis*; 23d of February. Young feathers appearing on the breast.

No. 11. *Fringilla cyanea*, male; May 3d. Moulting extensively. The young feathers coming forward nearly in bright colours.

No. 12, 13, 14, 15, 16, 17. *Sylvia coronata*; obtained from the 6th of March to the 10th of April. Every individual I obtained at the latter date, both male and female, was undergoing the change.

No. 18. *Sylvia coronata*; May 1st. Summer colours nearly restored. The moult has been general.

No. 19. *Fringilla palustris*; April. All the specimens procured at this season were in extensive moult.

No. 20. *Emberiza oryzivora*, Rice Bird; May 6th. Moulting on the breast. The young feathers coming forward nearly black.

No. 21. *Ardea cœrulea*, Blue Heron; female. This bird was obtained from the nest in June 1835; it became very gentle. On the following March it commenced moulting irregularly; all the new feathers were tinged, more or less, with blue. In July 1836, when a little more than a year old, it was accidentally killed.